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# Evaluation of the methodological quality of systematic reviews of health status measurement instruments

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**Abstract** A systematic review of measurement properties of health-status instruments is a tool for evaluating the quality of instruments. Our aim was to appraise the quality of the review process, to describe how authors assess the methodological quality of primary studies of measurement properties, and to describe how authors evaluate results of the studies. Literature searches were performed in three databases. One hundred and forty-eight reviews were included. The purpose of included reviews was to identify health status instruments used in an evaluative application and to report on the measurement properties of these instruments. Two independent reviewers selected the articles and extracted the data. Reviews were often of low quality: 22% of the reviews used one database, the search

strategy was often poorly described, and in many cases it was not reported whether article selection (75%) and data extraction (71%) was done by two independent reviewers. In 11 reviews the methodological quality of the primary studies was evaluated for all measurement properties, and of these 11 reviews only 7 evaluated the results. Methods to evaluate the quality of the primary studies and the results differed widely. The poor quality of reviews hampers evidence-based selection of instruments. Guidelines for conducting and reporting systematic reviews of measurement properties should be developed.

**Keywords** Systematic review · Measurement properties · Methodological quality · Health status

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## Introduction

Thousands of health status measurement instruments are used in research and clinical practice, and there are often many instruments for one single concept. Researchers, doctors, and policy-makers use the results obtained by instruments for further research, evidence-based patient care, guideline development, and evidence-based policy making.

The choice of an instrument depends on several factors, one of the most important being the measurement properties. The decision in favor of an instrument may have important consequences. Marshall et al. [1] showed that in schizophrenia trials authors were more likely to report that treatment was superior to control when an unpublished instrument was used in the comparison, rather than a published instrument. Furthermore, the selection of instruments with good measurement properties will lead to the detection of smaller treatment effects, or more power to draw stronger conclusions, and therefore to better interpretation of study results. In other words, if the measurement error of an instrument is small in relation to its minimal important change (MIC), one will be able to conduct clinical trials with relatively small sample sizes [2].

A systematic review of measurement properties critically appraises and compares the content and measurement properties of all instruments measuring a certain construct. High-quality systematic reviews of measurement properties provide evidence for the selection of the best instruments. The methodological quality of such a review should be thoroughly appraised in order to be confident that the design, conduct, analysis, and interpretation of the review was adequate, and to reveal any possible bias that might influence its conclusions. In general the critical appraisal of a systematic review consists of five steps: (1) reporting of relevant descriptive information, e.g., the target population, concept of interest, and the number of studies or instruments included, (2) appraisal of the quality of the review process, (3) appraisal of the methods used by the authors of reviews to assess the methodological quality of the primary studies included in the review, (4) appraisal of the results of the primary studies, and (5) a synthesis of the above mentioned data (steps 3 and 4) to come to an overall conclusion for each instrument.

Existing guidelines for the appraisal of systematic reviews of clinical trials (e.g., Cochrane Collaboration [3] or AMSTAR [4]) or diagnostic studies [5, 6] can be used to appraise the quality of the systematic review process (step 2). These guidelines contain items on the quality of the search strategy [4], article selection and data extraction [3, 7, 8], and inclusion and exclusion criteria [6]. The methodological quality of systematic reviews of measurement properties has not been systematically assessed yet.

Authors of reviews should appraise the methodological quality and results of the primary studies [3] (steps 3 and 4). Accepted guidelines are available to appraise the methodological quality of clinical trials (e.g., Delphi List [9]) or diagnostic studies (QUADAS [10]). Several guidelines have been developed to appraise the methodological quality of studies on measurement properties [e.g., 11–13]. It is unknown which of these guidelines are used most often in systematic reviews of measurement properties.

It was our aim (1) to find all existing systematic reviews of measurement properties, (2) to *appraise* the quality of the review process of these reviews, (3) to *describe* if and how the authors of reviews assessed the methodological quality of the primary studies included in these reviews, (4) to describe if and how the authors of reviews evaluated the results of the primary studies, and (5) to describe if authors of reviews synthesized the above-mentioned data (steps 3 and 4) to come to an overall conclusion regarding the quality of each instrument.

## Methods

### Identification of reviews

To identify systematic reviews of measurement properties, we searched PubMed (up to March 2007), EMBASE (up to March 2007), and PsycINFO (up to June 2005). The full search strategies can be found in Appendix 1. Additional articles were identified by manually searching references from the retrieved articles and the authors' own literature.

We included articles that

- Claimed to be “systematic reviews”
- Aimed to identify all available health status measurement instruments in a particular population, as stated by the author
- Concern health status measurement instruments that have been applied in an evaluative situation, i.e., instruments aimed to measure changes in health status over time in a longitudinal study
- Aimed to report on or evaluate the measurement properties of the measurement instruments

Based on guidelines for systematic reviews of back and neck pain trials [8], we considered a review to be systematic if at least one search in an electronic database was performed. We considered the following concepts to represent “health status” based on the model of Wilson and Cleary [14]: biological and physiological processes, symptoms, functional status (i.e., both physical functioning and psychosocial functioning), or general health perceptions. We consider health-related quality of life (HR-QoL)

as general health perception, and we excluded overall QoL. We excluded reviews that focused only on instruments applied in a discriminative situation, because these reviews are likely to have missed instruments that were used only in evaluative applications. We also excluded reviews that focused on instruments with a diagnostic or screening, or prognostic purpose.

Our aim was to find reviews that intended to find all available instruments for measuring a particular construct. We therefore excluded reviews of only one, or only the most commonly used instruments, or reviews that only included randomized clinical trials (RCTs). Reviews of RCTs very likely do not include all instruments that measure the construct of interest. Reviews that only described the instruments (e.g., format) were excluded. Only reviews written in English were included.

To determine the eligibility of the articles, two authors (L.M. and C.T.) independently reviewed title and abstract of every record retrieved from the searches. Full articles were retrieved for further assessment when the abstract suggested that the study might meet the inclusion criteria. Disagreements were resolved through consensus. A third reviewer (H.V.) was consulted in case of persisting disagreement.

#### Data extraction

Two authors (L.M. and C.T.) independently extracted data on (1) descriptive information, (2) the quality of the review process, (3) if and how the authors of reviews assessed the methodological quality of the primary studies included in the review, (4) if and how the results of the primary studies were evaluated and compared, and (5) if authors of reviews synthesized data to come to an overall conclusion on the quality of each instrument. Note that we only critically appraise the review process, and we simply describe if and how authors of reviews evaluate primary studies. A standard data extraction form was used (Appendix 2).

#### Descriptive information on reviews

Descriptive information that we extracted included year of publication, description of the health status concept of interest, study population of interest, number of health status instruments included, and type of health status instruments, i.e., patient-reported outcomes (PROs), proxy-reported outcomes or non-PROs. PRO was defined as a measurement of any aspect of a patient's health status that comes directly from the patient, i.e., without the interpretation of the patient's responses by a physician or anyone else [15]. Modes of data collection in PRO instruments

include interviewer-administered instruments, self-administered instruments, computer-administered instruments or interactively administered instruments [16]. Proxy-reported outcomes include any endpoint obtained from a proxy, such as parent-assessed ratings measuring health-related quality of life in childhood acute lymphoblastic leukaemia (ALL) [17], or reports of a caregiver measuring pain in nonverbal older adults with advanced dementia [18]. Non-PROs are instruments that are based on other sources than patient or proxy reports, such as performance-based instruments [19], or clinical ratings, for example, to measure the severity of asthma in preschool children [20]. Finally, we extracted which measurement properties were reported in each review, and how they were reported, i.e., whether the exact results were reported or only the references to the publications.

#### Appraisal of the review process

To appraise the quality of the review process, we recorded whether the search strategy was described, which databases were searched, whether article selection and data extraction were performed by at least two persons, and whether inclusion and exclusion criteria for primary studies were described.

#### Description of the assessment of the methodological quality of primary studies

To describe if and how the methodological quality of the primary studies was assessed by the authors of the reviews, we recorded whether the methodological quality of each primary study was evaluated, i.e., if standards were applied to the primary studies. Standards refer to the study design and statistical analyses. An example of a standard for reliability is "rating '+', when an intraclass correlation coefficient (ICC) was used." If one or more standards were applied, we recorded for which measurement properties standards were applied, which standards were applied, and whether they were described completely, i.e., were reproducible.

#### Description of the evaluation of the results of primary studies

To describe if and how the results of the primary studies were assessed by the authors of the reviews, we recorded whether they applied criteria of adequacy for what constitutes good measurement properties. An example is "ICC should be at least 0.70." We recorded whether the results were evaluated and, if so, for which measurement properties, which criteria were applied, and whether they were completely described, i.e., were reproducible.

## Description of synthesizing the methodological quality and the results

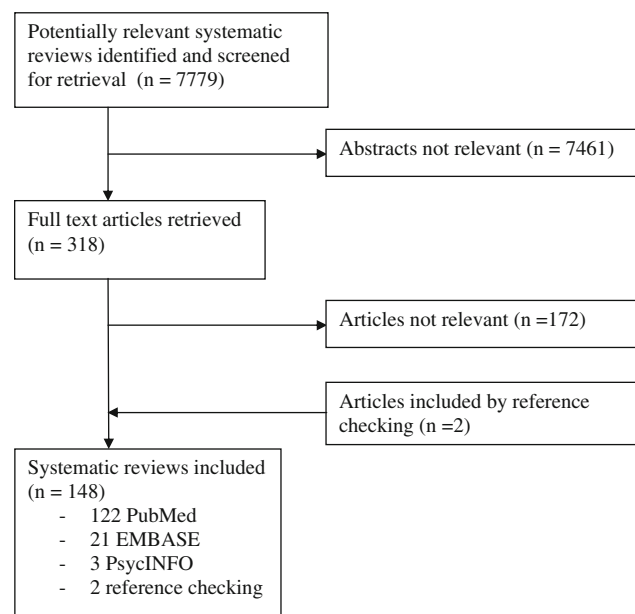
We furthermore documented two characteristics regarding whether or not authors of reviews formulated an overall conclusion for each instrument: we recorded whether authors gave a total score for the quality of each health status instrument, and we recorded whether some order of importance of the measurement properties was taken into account when giving a total score (see also Appendix 2).

## Results

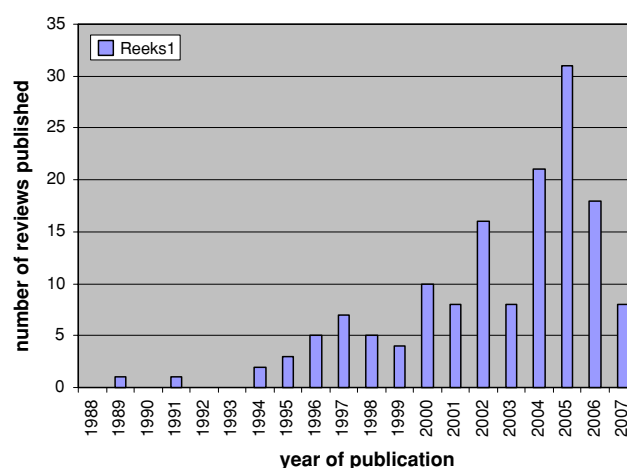
### Identification of reviews

The searches yielded 7,779 records. We included 148 systematic reviews of measurement properties (Fig. 1). Most of the excluded articles did not meet the inclusion criteria of being a systematic review of measurement properties of all available health status instruments; for example, we excluded reviews of only a selection of existing instruments, reviews of health status instruments used only in randomized clinical trials (RCTs), and reviews in which measurement properties were not reported or evaluated.

Publication of systematic reviews of measurement properties has increased from less than one review per year in the 1990s up to 31 in 2005 (Fig. 2). The decrease in the number of reviews published in 2006 is possibly due to a delay in the



**Fig. 1** Flowchart of selection process of systematic reviews of measurement properties



**Fig. 2** Number of systematic reviews of measurement properties published per year up to March 2007

recording of articles in PubMed and EMBASE. The concepts of interest in the included systematic reviews were general health perceptions (43%), functional status (21%), symptoms (17%), and biological and physiological processes (5%). The other reviews (14%) focused on a combination of these concepts. The reviews focused on a variety of populations, such as children, general population or patient populations with specific diseases, such as cerebral palsy or multiple sclerosis, or disease groups, such as cancer, neurological diseases or rheumatic disorders. Information about the study population and the number and type of instruments included in each review is presented in Table 1.

### Appraisal of the review process

Table 2 shows the results of the quality assessment of the review process of the systematic reviews with regard to the description of the search strategy, the databases used, the article selection and data extraction, and the description of inclusion and exclusion criteria. In 84% of the reviews the authors described the search strategy in some way. This varied from describing only the most important keywords to reporting the full search strategy, including MeSH terms and text words for each database. The search strategies were often limited. For example, only MeSH headings were used, and no free text words [21, 22]; or only a few synonyms were used, for example, only “measur\*” or “assess\*”; words such as “question\*”, “self-report”, “test”, “scale”, “outcome” or “interview” were not used [23]. In some reviews only the text words “psychometrics” [24] or “clinimetrics” [25] were used. Furthermore, the use of truncation was poorly described in most reviews. Finally, in quite a few reviews (14%) the time period during which the databases were searched, and some reviews (7%) searched a period of only 10 years or less was not specified.

**Table 1** Descriptive information of the included systematic reviews of measurement properties

Reference	Population	Health status concept	Year of publication	PRO <sup>a</sup>	Proxy <sup>b</sup>	Non-PRO <sup>c</sup>	Number of instr. <sup>d</sup>
<i>General health perception</i>							
Pickard [17]	Childhood acute lymphoblastic leukemia (ALL)	HR-QoL (health-related quality of life)	2004	Yes	Yes	Yes	20
Eiser [51]	Children	QoL (quality of life)	2001	Yes	Yes	No	43
Pal [52]	Children	Health status	1996	Yes	Yes	Yes	9
Schmidt [53]	Children and adolescents	HR-QoL	2002	Yes	Yes	No	16
Davis [54]	Children (0–12 years)	HR-QoL and QoL	2006	Yes	Yes	Yes	38
Hunter [55]	Children and adolescents	Mental health	1996	Yes	Yes	Yes	19
Brouwer [56]	Children with otitis media (0–18 years)	HR-QoL	2005	No	Yes	Yes	15
Haywood [57]	People aged 60 years and over	HR-QoL	2005	Yes	Yes	No	18
Haywood [39]	Older people aged 60 years and over	HR-QoL	2005	Yes	Yes	No	15
Haywood [58]	Older people	HR-QoL	2006	Yes	Yes	No	45
Hollifield [59]	Refugees	Health status (mental and physical), trauma, quality of care, and diagnostic	2002	Yes	No	No	12
Haywood [60]	Ankylosing spondylitis (AS)	Health or HR-QoL	2005	Yes	No	No	15
Namjoshi [61]	Bipolar disorder	HR-QoL	2001	Yes	No	No	14
Michalak [62]	Bipolar disorder	HR-QoL	2005	Yes	No	No	8
Okamoto [63]	Breast cancer	QoL	2003	Yes	No	No	11
Edwards [64]	Caregivers of patients with cancer	QoL	2002	Yes	No	No	4
Ringash [65]	Head and neck cancer	Disease-specific HR-QoL	2001	Yes	No	No	11
Van Korlaar [66]	Chronic venous disease	QoL	2003	Yes	No	No	16
Neelakantan [35]	Women with chronic pelvic pain	HR-QoL	2004	Yes	No	No	30
Riemsma [67]	Cognitive impairment due to acquired brain injury	General health status	2001	Yes	Yes	No	34
Jones [68]	Common chronic, benign gynecologic conditions	HR-QoL	2002	Yes	No	No	14
Ettema [69]	Dementia	QoL	2005	Yes	Yes	Yes	17
Salek [31]	Dementia/Alzheimer's	QoL	1998	Yes	Yes	No	9
Walker [32]	Dementia/Alzheimer's	QoL	1998	Yes	Yes	Yes	19
De Tiedra [70]	Dermatology	HR-QoL	1998	Yes	No	No	23
Garratt [71]	Diabetes mellitus (type 1 and 2)	Disease-specific HR-QoL	2002	Yes	No	No	9
Luscombe [72]	Diabetes mellitus type 2	HR-QoL	2000	Yes	No	No	31
Cagney [73]	End-stage renal disease (ESRD)	QoL	2000	Yes	No	No	53
Edgell [74]	End-stage renal disease (ESRD) patients	HR-QoL	1996	Yes	No	Yes	16
Kline [75]	Epilepsy and antiepileptic drug (AED) treatment	Condition specific HR-QoL	1998	Yes	No	No	4
Leone [76]	Epilepsy (adults)	HR-QoL	2005	Yes	No	No	45
Szende [77]	Hemophilia	HR-QoL and health status	2003	Yes	No	No	19
De Kleijn [78]	Hemophilia (age >16 years)	Health status: body structure, body function, activities	2002	Yes	No	Yes	34
De Boer [27]	HIV infected	HR-QoL	1995	Yes	No	No	12
Clayson [79]	HIV/AIDS	HR-QoL	2006	Yes	No	No	34
Bonomi [80]	Acute, chronic, and cancer pain	QoL, utility instruments	2000	Yes	No	No	18
Symonds [81]	Incontinence	HR-QoL	2003	Yes	No	No	10
Pallis [82]	Inflammatory bowel disease (IBD)	HR-QoL	2000	Yes	No	?	12
Cummins [83]	Intellectual disability	QoL	1997	Yes	No	No	13
Garratt [84]	Knee problems	Health and QoL	2004	Yes	No	No	16



**Table 1** continued

Reference	Population	Health status concept	Year of publication	PRO <sup>a</sup>	Proxy <sup>b</sup>	Non-PRO <sup>c</sup>	Number of instr. <sup>d</sup>
Zanoli [85]	Lumbar disorders	HR-QoL	2000	Yes	No	No	92
Clark [86]	Menorrhagia	QoL	2002	Yes	No	No	30
Van Nieuwenhuizen [87]	Mental illness (severe)	QoL	1997	Yes	Yes	Yes	11
Lehman [88]	Mental illnesses (severe and persistent)	QoL	1996	Yes	No	No	10
Gruenewald [24]	Multiple sclerosis (severe)	HR-QoL	2004	Yes	Yes	No	23
Marinus [89]	Parkinson's disease	QoL	2002	Yes	No	No	4
Heffernan [90]	Three degenerative neurological conditions: multiple sclerosis (MS), Parkinson's disease, and motor neuron disease (MND)	Disease-specific health status	2005	Yes	No	No	16
Jørstad [91]	Population over 50 years who had not suffered a stroke or Parkinson's disease, or had undergone a lower limb amputation	Fall-related psychological outcome measures	2005	Yes	No	?	26
Rannard [92]	Primary biliary cirrhosis (PBC)	HR-QoL	2004	Yes	No	Yes	20
De Korte [93]	Psoriasis	QoL	2002	Yes	No	No	6
Lewis [94]	Psoriasis	HR-QoL	2005	Yes	No	No	14
Hallin [95]	Spinal cord injury (SCI)	QoL	2000	Yes	No	No	14
Matza [96]	Stress urinary incontinence or overactive bladder (OAB)	Condition-specific HR-QoL	2004	Yes	No	?	16
Golomb [46]	Stroke	HR-QoL including functioning and well-being	2001	Yes	No	No	32
Buck [97]	Stroke	QoL	2000	Yes	No	No	25
Drake [26]	Total knee arthroplasty (TKA)	Global patient rating scales	1994	No	No	Yes	34
Prasad [98]	Working adults	Health-related work outcomes	2004	Yes	No	No	12
Lofland [99]	Various	Health-related loss in work productivity	2004	Yes	No	No	11
De Boer [34]	Vision impairments	Vision-related QoL	2004	Yes	No	No	31
Lundström [100]	Sight-threatening eye disease	HR-QoL/vision-related QoL	2006	Yes	No	No	16
Tripop [101]	Glaucoma	HR-QoL	2005	Yes	No	No	10
Franic [102]	Voice disorders	QoL	2005	Yes	No	No	9
Morley [103]	Chronic rhinosinusitis (patients undergoing endoscopic sinus surgery for)	HR-QoL	2006	Yes	No	No	20
Watt [104]	Benign thyroid disorders	HR-QoL	2006	Yes	No	No	6
<i>Functional status (physical and psychosocial)</i>							
Ketelaar [105]	Children with cerebral palsy	Disability	1998	No	No	Yes	17
Boyce [106]	Children with cerebral palsy	Motor performance or quality of movement	1991	No	No	Yes	10
Buffart [107]	Children with congenital (unilateral) transverse or longitudinal reduction deficiencies of the upper limb	Arm/hand functioning	2006	Yes	Yes	Yes	23
Pakulis [108]	Adolescent sarcoma patients (bone tumor)	Physical functioning	2005	Yes	No	Yes	7
Moore [109]	English-speaking adult population	Functional living skills	2006	No	No	Yes	31
Arrington [21]	Chronic medical or general populations	Sexual function	2004	Yes	No	No	57
MacKnight [110]	Community-dwelling elderly	Performance-based mobility	1995	No	No	Yes	41
Wind [111]	Healthy and disabled subjects	Functional capacity	2005	Yes	No	Yes	27
Ramaker [25]	Parkinson's disease	Impairment and disability	2002	No	No	Yes	11
Mannerkorpi [112]	Fibromyalgia syndrome (FMS)	Functional limitations and disability	1997	Yes	No	Yes	15

**Table 1** continued

Reference	Population	Health status concept	Year of publication	PRO <sup>a</sup>	Proxy <sup>b</sup>	Non-PRO <sup>c</sup>	Number of instr. <sup>d</sup>
Grotle [28]	Low back pain	Functional status and disability	2004	Yes	No	No	36
Millard [113]	Chronic pain	Pain-related disability	1997	Yes	No	No	35
Dowrick [114]	Musculoskeletal disorders of the upper extremity/orthopaedic trauma population (e.g., fracture or dislocation)	Functional outcomes	2005	Yes	No	Yes	7
Law [29]	Occupational therapy	Functional ability in activities of daily living (ADL)	1989	Yes	No	Yes	13
Terwee [19]	Osteoarthritis of the hip or knee	Physical function	2006	No	No	Yes	26
Dziedzic [115]	Osteoarthritis of the hand	Hand disability/functional disability	2005	Yes	No	No	5
Swinkels [116]	Rheumatic disorders	Personal care disabilities	2005	Yes	No	No	19
Swinkels [117]	Patients with rheumatic disorders	Impairments in functions	2005	Yes	No	Yes	49
Swinkels [118]	Rheumatic disorders	Impairment	2005	Yes	No	Yes	42
Swinkels [119]	Rheumatoid arthritis	Disabilities in gait and gait-related activities	2004	Yes	No	No	61
McKibbin [120]	Seriously mentally ill, schizophrenia	Functioning	2004	No	No	Yes	8
Keskula [121]	Shoulder conditions (athletes)	Functional limitations and disability	2001	Yes	No	Yes	9
Michener [122]	Shoulder dysfunction	Functional limitations and disability	2001	Yes	No	No	11
Bot [41]	Shoulder or shoulder-upper limb problems	Shoulder disability	2004	Yes	No	No	16
Salerno [123]	Disorders of the neck and upper extremity (mild to moderate)	Functional status	2002	Yes	No	No	13
Chong [124]	Stroke	Instrumental activities of daily living (IADL)	1995	Yes	No	Yes	4
Croarkin [125]	Stroke	Upper extremity motor function tests	2004	No	No	Yes	9
McGee [126]	Cardiac rehabilitation	Psychological outcome: depression, anxiety, and other negative affective states	1999	Yes	No	?	13
Sakzewski [127]	Children with cerebral palsy (5–13 years)	Participation	2007	Yes	Yes	Yes	7
Morris [128]	Children with cerebral palsy (5–15 years)	Activity performance and participation as defined by ICF	2005	Yes	Yes	No	7
Eadie [129]	Speech-language pathology	Communicative (functioning) participation	2006	Yes	No	No	6
<i>Symptoms</i>							
Brooks [130]	Adolescents	(Diagnose or measure) anxiety symptoms	2003	Yes	Yes	Yes	9
Duhn [131]	Infants	Pain assessment	2004	No	Yes	Yes	35
Ramelet [132]	Children (0–3 years)	Pain	2004	No	?	Yes	28
Stinson [133]	Children and adolescents	Pain	2006	Yes	No	No	7
Eccleston [134]	Adolescents (11–18 years)	(Impact of) pain	2005	Yes	Yes	No	43
Birken [135]	Preschool children (0–6 years)	Clinical asthma severity	2004	No	No	Yes	10
Linder [136]	Children with cancer (0–18 years)	Physical symptoms	2005	Yes	Yes	Yes	23
Stover [137]	Children less than 6 years old	PTSD symptoms and diagnostic measures	2005	Yes	Yes	Yes	7
Devine [138]	Adults	Sleep dysfunction	2005	Yes	No	Yes	22
Kirkova [139]	Adult cancer patients	Cancer symptoms	2006	Yes	Yes	Yes	21



**Table 1** continued

Reference	Population	Health status concept	Year of publication	PRO <sup>a</sup>	Proxy <sup>b</sup>	Non-PRO <sup>c</sup>	Number of instr. <sup>d</sup>
Vadaparampil [140]	Adults with hereditary breast, ovarian, and colon cancer	Psychological factors (depression, anxiety or distress)	2005	Yes	No	No	11
Van Herk [141]	Older adults with severe cognitive impairments or communication difficulties	Pain	2007	No	No	Yes	13
Stolee [142]	Cognitively impaired older persons	Pain	2005	Yes	No	Yes	30
Zwakhalen [143]	Elderly people with dementia	Pain	2006	No	No	Yes	12
Herr [144]	Nonverbal older adults with dementia	Pain	2006	No	No	Yes	10
Smith [18]	Nonverbal older adults with advanced dementia	Pain	2005	No	Yes	Yes	7
Schofield [145]	Adults with cognitive impairment	Pain	2005	Yes	Yes	Yes	9
Schuurmans [146]	Delirium	Delirium (symptom severity)	2003	Yes	No	Yes	8
Stanghellini [22]	Gastro-oesophageal reflux disease (GERD)	Symptom scales	2004	Yes	No	Yes	20
Fraser [147]	Gastro-oesophageal reflux disease (GERD) or dyspepsia	Frequency or severity of GERD or dyspepsia symptoms	2005	Yes	No	No	26
Bouchard [148]	Panic, panic disorders, agoraphobia	Aspects of panic attacks or panic disorder	1997	Yes	No	No	14
Dorman [36]	Patients in palliative care	Breathlessness	2007	Yes	?	?	29
Bausewein [149]	Chronic conditions such as OPD, cancer, chronic heart failure, and motor neuron disease	Breathlessness	2007	Yes	No	Yes	33
Dittner [150]	Various	Fatigue	2004	Yes	No	?	30
Mota [151]	Adults	Fatigue	2006	Yes	No	No	18
<i>Biological and physiological processes</i>							
Van der Windt [20]	Preschool children (0–5 years)	Clinical scores for acute asthma	1994	No	No	Yes	8
Moreau [152]	Low back pain	Isometric back extension endurance	2001	No	No	Yes	6
Charman [153]	Atopic eczema	Disease-specific objective skin examination scales (severity)	2000	No	No	Yes	13
Sun [154]	Osteoarthritis of hip and knee joints	Clinical rating systems	1997	Yes	No	Yes	45
Innes [155]	General population/occupational therapy	Grip strength	1999	No	No	Yes	13
Kettler [156]	People with cervical and lumbar disc and facet joint degeneration	Grading systems	2006	No	No	Yes	42
Hudson [157]	Systemic sclerosis	Disease activity in systemic sclerosis	2007	No	No	Yes	3
<i>Combination</i>							
Daker-White [33]	General population	Sexual function, satisfaction or quality of life	2002	Yes	No	No	23
Creameens [158]	Children (3–8 years)	QoL, self-esteem, self-concept, and mental health measures	2006	Yes	No	No	53
Hayes [159]	Critical care survivors	Impairment, functional status, and HR-QoL outcome measures	2000	Yes	No	Yes	36
Pietronbon [160]	Various	Neck pain or dysfunction	2002	Yes	No	No	5
Linder [161]	Acute sinusitis	HR-QoL and symptom scores	2003	Yes	No	No	21
Hearn [162]	Cancer (advanced)	Outcome measures	1997	Yes	Yes	Yes	12
Eechaute [42]	Chronic ankle instability	Patient-assessed instruments	2007	Yes	No	No	3

**Table 1** continued

Reference	Population	Health status concept	Year of publication	PRO <sup>a</sup>	Proxy <sup>b</sup>	Non-PRO <sup>c</sup>	Number of instr. <sup>d</sup>
Dorey [38]	Erectile dysfunction	Outcome measure	2002	Yes	Yes	Yes	26
Veenhof [30]	Hip and/or knee OA	Pain, physical function, and patient global assessment	2006	Yes	No	No	32
Razvi [163]	Hypothyroidism (adult)	Symptoms, health status, and QoL	2005	Yes	No	Yes	9
Bijkerk [164]	Inflammatory bowel syndrome (IBS)	HR-QoL or symptoms	2003	Yes	No	?	10
Haywood [165]	Lateral ligament injury of the ankle	Multi-item measures of health outcome	2004	Yes	No	Yes	9
Costa [43]	Low back pain	Outcome measures	2007	Yes	No	No	15
Poolsup [166]	Mania	Global rating scales and symptom rating scales	1999	Yes	No	Yes	13
Platz [23]	Spasticity	Clinical phenomena, function (ability to perform an activity independently)	2005	Yes	No	Yes	37
D'Olhaberria-gue [167]	Stroke	Neurological examination; deficit or handicap and disability	1996	No	No	Yes	14
Van Tuijl [40]	Tetraplegics	Upper extremity tests: strength tests, functional tests, and ADL tests	2002	Yes	No	Yes	24
Margolis [168]	Visually impairments	Vision-specific HR-QOL or functioning or impact	2002	Yes	No	No	22
Ashcroft [169]	Psoriasis	Clinical outcome measures to evaluate severity of psoriasis and its response to treatment	1999	Yes	No	Yes	7
Avery [37]	Urinary and anal incontinence and vaginal and pelvic problems	QoL and symptoms	2007	Yes	No	No	23
Bialocerkowski [170]	Wrist complaints	Wrist outcome instruments, performance or function	2000	Yes	No	Yes	32

ICF International Classification of Functioning, Disability and Health, PTSD Post-traumatic stress disorder

<sup>a</sup> Patient-reported outcomes

<sup>b</sup> Proxy-reported outcomes

<sup>c</sup> Non-patient-reported outcomes, such as clinical ratings and performance-based outcomes

<sup>d</sup> Number of instruments included in the systematic review

Description of the assessment of the methodological quality of the primary studies and evaluation of the results

In 44% ( $n = 65/148$ ) of the reviews the methodological quality of the included studies was not assessed and the results were not appraised, but only reported, i.e., steps 3 and 4 were omitted.

Of these reviews, 32% ( $n = 21/65$ ) only reported references of the primary studies and not the results; 38% ( $n = 25/65$ ) reported the results, 28% ( $n = 18/65$ ) reported partly results and partly references, and 2% ( $n = 1/65$ ) stated that no studies of measurement properties were found for any of the included instruments [26]. References were mainly reported for validity, and results for reliability.

In 56% ( $n = 83/148$ ) of the reviews the methodological quality of the included studies was (partly) assessed by the authors of the reviews and (some of) the results were evaluated, i.e., standards and/or criteria of adequacy were applied to one or more measurement properties (steps 3 and 4). In 53% ( $n = 44/83$ ) of these reviews (some) standards as well as criteria of adequacy were applied. In 46% ( $n = 38/83$ ) of these reviews only (some) criteria of adequacy were applied, and in one review only standards were applied.

Often a limited number of standards and/or criteria of adequacy were applied; for example, in some cases only a standard and a criterion for internal consistency were used [27]. Eleven reviews described and applied a complete set of standards, i.e., fully described and reproducible standards of reliability, validity, and responsiveness.

**Table 2** Assessment of the quality of the review process of systematic reviews of measurement properties

Search strategy described	
Yes	84%
No	16%
Number of databases used	
1	22%
2	20%
3	16%
4	17%
>4	24%
Unclear	2%
Databases used	
PubMed	93%
PsycINFO	40%
CINAHL	39%
EMBASE	35%
Cochrane library	16%
Selection of articles performed by at least two reviewers	
Yes	22%
No	3%
Unclear	75%
Data extraction performed by at least two reviewers	
Yes	25%
No	4%
Unclear	71%
Inclusion and exclusion criteria of primary studies described	
Yes	72%
No	28%

Twelve reviews described and applied a complete set of criteria of adequacy, i.e., fully described and reproducible criteria of adequacy of reliability, validity, and responsiveness. In seven reviews both a complete set of standards and a complete set of criteria of adequacy were described and applied.

In Table 3 we summarize the standards and criteria of adequacy used by the authors of the reviews. Standards were most often applied for reliability (use of an ICC), internal consistency (use of Cronbach's alpha), and construct validity (confirming hypotheses). Criteria of adequacy were most often applied for reliability (e.g., ICC > 0.70) and for internal consistency (Cronbach's alpha > 0.70). Standards and criteria of adequacy for measurement error and interpretability were rarely used. Few authors of reviews mentioned that the use of Pearson's correlation coefficients was not adequate to measure reliability [19, 28, 29]. Only two reviews gave an exact number as a minimum of the sample size (i.e., at least 50) for reliability [19, 30] and two reviews required that the sample size for reliability must be "reasonably large" [31, 32]. Criteria for construct validity varied from

qualitative criteria such as "hypotheses confirmed" to quantitative criteria such as " $r \geq 0.40$ ." Standards given for responsiveness included confirming hypotheses, effect sizes or standardized response mean or other methods.

#### Description of synthesizing methodological quality and results

In 7% ( $n = 10/148$ ) of the systematic reviews a total score was given for the quality of each instrument, and in 5% ( $n = 8/148$ ) of the systematic reviews an order of importance of measurement properties was taken into account when making the quality assessment. There was no agreement among the reviews regarding which property was most important. Some considered content validity as most important [33–35], while others considered construct validity [36], responsiveness [29, 36] or validity and reliability [37] as the most important measurement properties.

The reviews frequently used rating systems to indicate whether a standard or a criterion of adequacy was met. Different rating systems were used. An example of a nonspecified rating system is "0 = no numerical results reported; + = weak evidence; ++ = adequate evidence; +++ = good evidence" [38–40]. An example of a rating system in which the standard and the criterion are combined is "+ adequate design & method (i.e. factor analysis and Cronbach's alpha), and alpha is between 0.70 and 0.90;  $\pm$  doubtful method used (no factor analysis); – inadequate internal consistency (alpha < 0.70); ? no information found on internal consistency" [30, 41, 42].

## Discussion

It was our aim to identify all systematic reviews of measurement properties, to appraise the quality of the review process, and to describe whether the authors of the reviews appraised the methodological quality and results of the primary studies. We observed an increase in published systematic reviews of measurement properties in the last few years. Information required to assess the quality of the review process is often poorly described. More than half of the authors of the reviews evaluated neither the methodological quality of the primary studies nor the results of these studies. The reviews that did evaluate methodological quality and results used different standards and criteria of adequacy.

We attempted to use transparent and reproducible methods. However, because of the considerable variation in design, performance, and data presentation of the included reviews, some degree of judgement in appraising the quality of the systematic reviews and describing the standards and criteria was unavoidable.

**Table 3** Summary of standards and criteria of adequacy applied in the systematic reviews of measurement properties*Internal consistency*Standards<sup>a</sup> (23×<sup>b</sup>)

- Cronbach's alpha (18×)
- KR-20 (2×), kappa (1×)
- Cronbach's alpha is calculated for either the whole scale or for subscales depending on the outcome of the factor analysis (5×)
- Rasch analysis (2×)
- Rating system not specified (2×)

Criteria of adequacy<sup>c</sup> (45×)

- Alpha > 0.70 (26×)
- Alpha < 0.90 (9×), or not too high (1×)
- Alpha > 0.80 (3×)
- Alpha > 0.95 (2×)
- Range (e.g., 0.00–0.39 low; 0.40–0.59 moderate; 0.60–0.79 moderately high; 0.80–1.0 high, or alpha < 0.70 questionable; 0.71–0.80 moderate; >0.80 good) (10×)
- Distinction between cut-off score for group level and clinical use (2×)
- Rating system not specified (2×)

*Reliability*

## Standards (29×)

- ICC: (18×)
- Kappa (10×)
- Correlation coefficient (e.g., Pearson's or Spearman) (11×)
- Correlation not adequate (3×)
- Time interval mentioned (3×)
- Other measures, e.g., MDC, CV, Kendall's tau, *t*-test, Goodman-Kruskall gamma, odds ratio, percentage agreement (7×)
- Rating system not specified (7×)

## Criteria of adequacy (57×)

- ICC > 0.70 (19×)
- ICC between 0.70 and 0.90 (7×)
- ICC > 0.50 (1×), >0.60 (2×), >0.75 (2×), >0.80 (3×), >0.90 (7×)
- Lower limit ICC > 0.60 (1×)
- Range ICC, kappa or *r* (18×)
- Distinction between, e.g., test-retest reliability and interrater reliability or discriminative versus evaluative use (3×)
- Minimum sample size (3×)
- Rating system not specified (13×)
- Example: Test-retest reliability: ICC < 0.6; ±ICC 0.6–0.8; +ICC > 0.8; Interobserver reliability: ICC < 0.5; ±ICC 0.5–0.7; +ICC > 0.7.

*Measurement error*

## Standards (6×)

- Bland & Altman 95% LoA (5×)
- SEM (5×)
- Kappa (3×)
- MDC (1×)
- SDD/SDC (2×)

## Criteria of adequacy (4×)

- Rating system not specified (3×)
- LoA or SDC < M(C)IC (1×)

*Validity*

## Standards (6×)

- Rating system not specified (3×)

## Criteria of adequacy (13×)

- Rating system not specified (12×)
- Correlation between 0.4 and 0.8 (1×)

*Content validity*

## Standards and/or criteria of adequacy (21×)

- Involvement of patients (7×)
- Judgement by reviewer (3×)
- Involvement of experts (4×)
- Examining the literature (2×)
- Statistical procedure (e.g., impact method, principal component analysis) (4×)
- Rating system not specified (3×)

*Construct validity*

## Standards (26×)

## Criteria of adequacy (28×)

**Table 3** continued

Confirming hypotheses (11×)	Range (e.g., Cohen's criteria or other, e.g., 0–0.39, 0.4–0.59, 0.6–0.79, 0.8–1.0) (11×)
Calculation of correlation (8×)	Hypotheses confirmed (7×)
Distinction between different forms of validity (e.g., convergent validity, divergent validity, known group validity) (6×)	One cut-off point (e.g., $r \geq 0.40$ , or specified for, e.g., convergent validity, discriminant validity, known groups validity) (5×)
Rating system not specified (3×)	Rating system not specified (3×)
	Other (e.g., number of populations validated) (2×)
<i>Criterion validity</i>	
Standards (4×)	Criteria of adequacy (8×)
Correlation of percentage agreement between instrument and “gold standard” (4×)	Range (for correlations, kappa, or ES/SRM, e.g., “0.00–0.39 low; 0.40–0.59 moderate; 0.60–0.79 moderately high; 0.80–1.0 high,” or “high $\geq 90\%$ , $\kappa > 0.60$ , $r > 0.75$ ; moderate $\geq 70\%$ , $\kappa \geq 0.40$ , $r \geq 0.50$ ; low $< 70\%$ , $\kappa < 0.40$ , $r < 0.50$ ) (5×)
Magnitude of the coefficients is hypothesis dependent (1×)	Significant correlations (1×)
	Rating system not specified (2×)
<i>Responsiveness</i>	
Standards (17×)	Criteria of adequacy (26×)
“Adequate measure” used, e.g., ES, SRM (7×)	Range or cut-off point for ES or SRM (11×)
Confirming hypotheses (6×)	Hypotheses testing (5×)
Calculating change scores (3×)	Significant difference (2×)
Other measures, e.g., ROC curves (1×), Guyatt index of responsiveness (1×), relative efficacy (1×), Student's <i>t</i> -test/Wilcoxon's test (1×)	ROC curve (1×)
Rating system not specified (5×)	Intervention of known efficacy (1×)
	Rating system not specified (9×)
<i>Interpretability</i>	
Standards and/or criteria of adequacy (7×)	
Presenting MIC/MCIC (4×)	
Presenting mean and SDs (e.g., for different subgroups, or before and after treatment) (4×)	
Rating system not specified (1×)	

*MDC* minimal detectable change, *CV* coefficient of variation, *LoA* limits of agreement, *SEM* standard error of measurement, *SDD/SDC* smallest detectable difference/change, *M(C)IC* minimal (clinically) important change, *ES* effect size, *SRM* standardized response mean

<sup>a</sup> Standards refer to the study design and statistical analyses

<sup>b</sup> Number of reviews in which the standard/criterion is mentioned

<sup>c</sup> Criteria of adequacy refer to what constitutes good measurement properties

We identified three major aspects: a lack of methodological quality of systematic reviews of measurement properties, i.e., low quality of search strategy, a lack of good reporting of the methods used to perform the systematic review, and a lack of use of standards and criteria of adequacy to assess the methodological quality of the primary studies.

#### Appraisal of the review process

Firstly, the quality and reporting of the search strategy was often poor. It was obvious that search strategies were often too narrow and that many systematic reviews were likely to be incomplete; for example, Costa et al. [43] found 17

primary studies on the Roland Morris Disability Questionnaire (RDQ) by using a search strategy consisting of several terms for low back pain with the terms “questionnaire(s) OR outcome measure(s) OR index OR scale”. However, a simple PubMed search “Roland AND (responsive\* OR sensitiv\*)” resulted in 11 additional responsiveness studies of the RDQ that were not included in the review. Furthermore, the review of Costa was limited to a time period from January 2001 to July 2007. With our simple PubMed search described above, we found another 12 responsiveness studies of the RDQ before 2001.

We recommend that the search strategy consist of terms describing the concept to be measured, terms describing the population of interest, and terms describing the type of

instruments of interest, such as questionnaire, performance-based measure, etc. For each of these parts a comprehensive list of possible synonyms should be used, preferably drawn up in cooperation with a clinical librarian. Platz et al. [23] published a systematic review that aimed to characterize clinical assessment methods for spasticity and/or functional consequences in clinical patient populations at risk to suffer from spasticity. Their search strategy was adequate. They started with search terms for the construct (i.e., spas\*, hyperton\* or reflex\*), secondly they used terms for the type of instrument (i.e., measure\* or assess\*) and thirdly terms for the population of interest (i.e., stroke or CVA or multiple sclerosis or MS or spinal cord injury or SCI or cerebral palsy or CP). Additionally, we recommend not to limit the search to a specific time period.

In many search strategies the focus is on finding all health status instruments, without focusing on finding all studies of measurement properties of these instruments. An additional search strategy, including the names of the instruments, is often needed to find all these studies. In our experience these studies of measurement properties do not always contain terms of measurement properties such as “reliability,” “validity,” and “responsiveness” in the title, abstract or keywords. Furthermore, the large variety in terms of measurement properties used in the literature makes it difficult to design a sensitive search strategy. The use of a methodological search filter with terms for measurement properties will inevitably result in missing studies and should therefore be discouraged. This is in line with what is known about the performance of other methodological search filters, e.g., for finding diagnostic studies [44]. In 21% of the reviews only one database was used. In guidelines for systematic reviews of clinical trials [3, 8] and observational studies [45] it is suggested that limiting a search to a single database will not provide a thorough summary of the existing literature.

Secondly, there is a lack of adequate reporting of the methods used in the systematic reviews of measurement properties. Because of this, it is difficult to assess the methodological quality of the reviews. It was often unclear if things were not done (e.g., data extraction performed by at least two independent reviewers) or if they were not reported. For example, Law and Letts clearly described that the data extraction was performed by two people, but they did not describe if the article selection was also performed by two people [29]. As we only used information from the published reviews and did not contact authors to ask for additional information, it is possible that we may have slightly underrated the quality of the reviews. However, we believe that our article clearly shows the need for guidelines for assessing the quality of systematic reviews of measurement properties and guidelines for reporting on these reviews.

Description of the assessment of the methodological quality of primary studies and the evaluation of the results of primary studies

Thirdly, more than half of the reviews did not evaluate either the methodological quality of the primary studies (step 3), or the results of these studies (step 4), i.e., standards for the appropriateness of the study design and statistical analyses, and criteria for what constitutes good measurement properties were often not applied; for example, Golomb et al. [46] published a review on health-related quality-of-life measures in stroke. They provided definitions of the measurement properties and adequately described the results of the measurement properties for each of the available measurement instruments, but they did not apply a priori determined standards to the methods used to assess the measurement properties, or criteria of adequacy to the results of those studies.

In our opinion it is important to assess the methodological quality of included primary studies in order to decrease the risk of bias in the review. Considering the large variety of methods used to evaluate the methodological quality of the individual studies, there is a need for guidance. Within this guidance more attention should be paid to techniques based on item response theory (IRT). IRT has many advantages over classical test theory; for example, shorter questionnaires with equal or even better reliability can be developed [47]. Furthermore, the ability scores are test independent [48], and scores obtained on different instruments measuring the same construct can be linked, so that they are comparable [49]. We think that standards and criteria of adequacy are most likely to be widely used when consensus is reached among international experts about the preferred standards and criteria of adequacy. We therefore started the Consensus-based Standards for the selection of health Measurement INstruments (COSMIN) initiative with the aim to draw up a consensus-based checklist for the evaluation of the methodological quality of studies on measurement properties [50].

## Conclusion

A systematic review of measurement properties is a useful tool for evaluating the quality of an instrument, or for interpreting results based on an instrument. In the last few years the number of such systematic reviews published has increased enormously every year. However, the methodological quality of these reviews leaves much to be desired and should be improved. We feel it is essential to develop guidelines for the assessment of the methodological quality of systematic reviews of measurement properties. This includes guidelines for the review process, guidelines to assess the methodological quality of the studies that



evaluate measurement properties, and guidelines for criteria of adequacy for good measurement properties.

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**Conflict of interest** The authors of this review, except IR, are all members of the Steering Committee of the COSMIN study.

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## Appendix 1: Search strategies

### PubMed

(instruments[tiab] OR scales[tiab] OR Questionnaires[tiab] OR measures[ti] OR methods[ti] OR outcome measurements[tiab] OR (tests[tiab] AND review[tiab]) OR Questionnaires[MeSH] OR interview[MeSH])

AND

(systematic[sb] OR (literature AND search\*) OR (Medline AND search\*) OR review[ti])

AND

(reproducibility of results[MeSH] OR Psychometrics[MeSH] OR Observer variation[MeSH] OR quality[ti] OR assess\*[ti] OR validation studies[pt] OR evaluation studies[pt] OR reproduc\*[tiab] OR reliab\*[tiab] OR intraclass correlation[tiab] OR internal consistency[tiab] OR valid\*[tiab] OR responsive\*[tiab] OR agreement[tiab] OR factor analysis[tiab] OR factor analyses[tiab] OR factor structure[tiab] OR discriminant analysis[tiab] OR ((clinimetric[tiab] OR psychometric[tiab]) AND (propert\*[tiab] OR analys\*[tiab])) OR (measurement[tiab] AND propert\*[tiab]) OR ((minimal\*[tiab] OR smallest[tiab]) AND (important[tiab] OR detectable[tiab] OR real[tiab]) AND (change[tiab] OR difference[tiab])))

NOT

(meta-analysis[pt] OR meta-analysis[ti] OR metaanalysis[ti] OR case reports[pt] OR 'delphi-technique'[ti] OR cross-sectional[ti]) NOT (animal[mesh] NOT human[mesh])

EMBASE (through Embase.com)

### Bloc 1:

instruments:ti,ab OR scales:ti,ab OR questionnaires:ti,ab OR measures:ti OR methods:ti OR outcome-measurements:ti,ab

OR (tests:ti,ab AND review:ti,ab) OR 'outcomes research'/de OR 'treatment outcome'/de OR 'psychologic test'/de OR 'measurement'/de OR 'functional assessment'/de OR 'pain assessment'/de OR 'questionnaire'/de OR 'rating scale'/de

### Bloc 2:

review:ti OR (literature AND search\*) OR (medline AND search\*) OR 'systematic review'/exp

### Bloc 3:

quality:ti OR assess\*:ti OR reproduc\*:ti,ab OR reliab\*:ti,ab OR intraclass-correlation:ti,ab OR internal-consistency:ti,ab OR valid\*:ti,ab OR responsive\*:ti,ab OR agreement:ti,ab OR factor-analysis:ti,ab OR factor-analyses:ti,ab OR factor-structure:ti,ab OR discriminant-analysis:ti,ab OR ((clinimetric:ti,ab OR psychometric:ti,ab) AND (propert\*:ti,ab OR analys\*:ti,ab)) OR (measurement:ti,ab AND propert\*:ti,ab) OR ((minimal\*:ti,ab OR smallest:ti,ab) AND (important:ti,ab OR detectable:ti,ab OR real:ti,ab) AND (change:ti,ab OR difference:ti,ab)) OR 'psychometry'/exp OR 'clinimetry'/exp OR 'observer variation'/exp OR 'reliability'/exp OR 'reproducibility'/exp OR 'variance'/exp OR 'correlation coefficient'/exp OR 'validation process'/exp

### Bloc 4:

meta-analysis:ti OR meta-analyses:ti OR 'Delphi technique':ti OR Cross-sectional:ti OR 'diagnosis'/exp OR 'case report'/de OR 'meta-analysis':it OR 'screening'/exp OR letter:it OR animal/exp OR 'animal model'/exp OR 'animal experiment'/exp

(#1 AND #2 AND #3) NOT #4 AND [embase]/lim

PsycINFO (through WebSPIRS)

### Bloc 1:

(instruments in ti,ab) or (scales in ti,ab) or (Questionnaires in ti,ab) or (measures in ti) or (methods in ti) or (outcome measurements in ti,ab) or ((tests in ti,ab) and (review in ti,ab)) or (explode "Attitude-Measures" in MJ,MN) or (explode "Questionnaires-" in MJ,MN) or (explode "Psychotherapeutic-Outcomes" in MJ,MN) or (explode "Treatment-Outcomes" in MJ,MN) or (explode "Psychological-Assessment" in MJ,MN) or (explode "Measurement-" in MJ,MN) or (explode "Pain-Measurement" in MJ,MN) or (explode "Interviewing-" in MJ,MN)

### Bloc 2:

(literature and search\*) or (Medline and search\*) or (Psycinfo and search\*) or (Psychlit and search\*) or (review in

ti) or (explode “Literature-Review” in MJ,MN) or (REVIEW in DT)

#### Bloc 3:

(explode “Psychometrics-” in MJ,MN) or (explode “Statistical-Validity” in MJ,MN) or (explode “Test-Validity” in MJ,MN) or (explode “Statistical-Reliability” in MJ,MN) or (explode “Test-Reliability” in MJ,MN) or (explode “Test-Scores” in MJ,MN) or (explode “Test-Interpretation” in MJ,MN) or (explode “Test-Items” in MJ,MN) or (explode “Response-Variability” in MJ,MN) or (explode “Variability-Measurement” in MJ,MN) or (explode “Statistical-Correlation” in MJ,MN) or (explode “Response-Variability” in MJ,MN) or (explode “Variability-Measurement” in MJ,MN) or (explode “Error-of-Measurement” in MJ,MN) or (explode “Consistency-Measurement” in MJ,MN) or (explode “Statistical-Correlation” in MJ,MN) or (explode “Statistical-Measurement” in MJ,MN) or (quality in ti) or (assess\* in ti) or (reproduc\* in ti,ab) or (reliab\* in ti,ab) or (intraclass correlation in ti,ab) or (internal consistency in ti,ab) or (valid\* in ti,ab) or (responsive\* in ti,ab) or (agreement in ti,ab) or (factor analysis in ti,ab) or (factor analyses in ti,ab) or (factor structure in ti,ab) or (discriminant analysis in ti,ab) or (((clinimetric in ti,ab) or (psychometric in ti,ab)) and ((property\* in ti,ab) or (analys\* in ti,ab))) or ((measurement in ti,ab) and (property\* in ti,ab)) or (((minimal\* in ti,ab) or (smallest in ti,ab)) and ((important in ti,ab) or (detectable in ti,ab) or (real in ti,ab)) and ((change in ti,ab) or (difference in ti,ab)))

#### Bloc 4:

(explode “Meta-Analysis” in MJ,MN) or (meta analysis in ti) or (metaanalysis in ti) or (delphi technique in ti) or (cross sectional in ti) or (explode “Diagnosis-” in MJ,MN) or (explode “Case-Report” in MJ,MN) or (explode “Screening-Tests” in MJ,MN)

(#1 and #2 and #3) NOT #4

## Appendix 2

Data extraction form COSMIN review

1.	Review number: .....
2.	First author: .....

## Appendix 2 continued

3. Health status concept—according to authors—that the reviewed measurement instruments are supposed to measure: *multiple answers possible*
    - ☐ Biological and physiological process
    - ☐ Symptoms
    - ☐ Physical functioning
    - ☐ Social psychological functioning
    - ☐ General health perception (including health-related quality of life)
    - Other: .....
  4. Type of measurement instruments that are being reviewed: *multiple answers possible*
    - ☐ PRO (e.g. self-administered, interview, telephone administered)
    - ☐ Proxy
    - ☐ Non-PRO (e.g. performance based test, observation or rating by professional, clinical value (e.g. lab value))
    - ☐ Other: .....
  5. Target population(s) in with the reviewed measurement instrument were validated  
.....
  6. Number of measurement instruments included in the review:  
.....
  7. Is the search strategy used and described? Described—not descr
  8. Which databases are searched? .....
  9. Is the selection of articles performed by at least two reviewers? Yes/no/?
  10. Is the data extraction performed by at least two reviewers? Yes/no/?/n.a.
  11. Did the authors search for all validation studies per measurement instrument?
    - ☐ Yes
    - ☐ Probably yes
    - ☐ No
    - ☐ Don't know
  12. Are the in- and exclusion criteria for articles described? Yes/no
  13. Gave the authors a total assessment of the quality of each measurement instrument (inclusion of all measurement prop)? Yes/no
  14. Is some order of importance of the properties taken into account? Yes/no
  15. Which properties are reported:  
.....
  16. How are they reported? (references or values?):  
.....
- Methodological quality of individual studies
17. Are one or more standards applied?
  18. Which standards (per property) and are they fully described (i.e. reproducible)?
  19. Is per measurement instrument described if it fulfils the standard?

## Appendix 2 continued

## Results of individual studies

20. Are the results evaluated, i.e. are one or more criteria applied?
21. Which criteria (per property) and are they fully described (i.e. reproducible)?
22. Is per measurement instrument described if it fulfils the criterion?

## References

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